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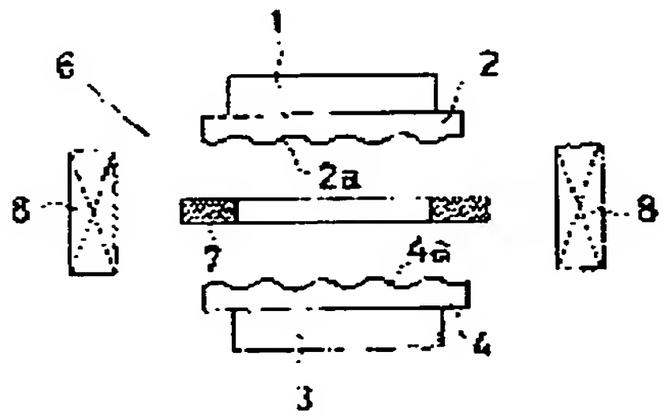
(54) PLASTIC WELDING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a stable welding strength even when a welding work has poor adhesiveness on the contact face, in conducting laser welding by using a semiconductor laser.
SOLUTION: In conducting the laser welding by bringing the welding flange 2 of a first welding work 1 into contact with the welding flange 4 of a second welding work 3, both contact faces 2a, 4a are, prior to the laser welding, preheated at temperatures higher than the thermal deformation temperature of both welding works 1, 3. The preheating is conducted by an electromagnetic induction heating method using a heating plate 7 and a heating coil 8, thereby softening both the contact faces 2a, 4a to enable the adhesiveness to be improved in executing the laser welding by contacting both the contact faces 2a, 4a.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1]
Contact the penetrable ingredient which has big laser beam permeability, and the absorptivity ingredient which has small laser beam permeability, and semiconductor laser light is irradiated into said penetrable ingredient in the contact surface with a through absorptivity ingredient. The plastics joining approach which carries out preheating of one of the adhesion sides at the temperature more than the heat deflection temperature of an ingredient, and is characterized by the thing of said penetrable ingredient or the absorptivity ingredients for which both ingredients are subsequently contacted and laser joining is performed at least in the plastics joining approach which welds both ingredients.
[Claim 2]
The plastics joining approach according to claim 1 which pressurizes and carries out temporary welding after preheating while contacting both ingredients, and is characterized by subsequently performing laser joining of both ingredients.
[Claim 3]
The plastics joining approach according to claim 1 or 2 characterized by arranging a preheating means and evacuating a preheating means from between both ingredients after preheating among both ingredients while carrying out opposite arrangement of a penetrable ingredient and the absorptivity ingredient.
[Claim 4]
A preheating means is the plastics joining approach according to claim 3 characterized by having the hot plate allotted among both ingredients, and the source of heating which heats this hot plate by the electromagnetic-induction heating method.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention relates to the plastics joining approach which welds plastics material using semiconductor laser, especially even if the adhesion of the contact surface is a bad case, it relates to the plastics joining approach that the stable joining reinforcement can be obtained.
[0002]
[Description of the Prior Art]
Semiconductor laser light is irradiated into the penetrable ingredient which has big laser permeability from the former, and the absorptivity ingredient which has small laser beam permeability from the outside of superposition and a penetrable ingredient in the contact surface of both ingredients, and, generally the plastics joining approach which welds both ingredients is learned.
[0003]
By the way, in order to acquire the joining condition stabilized since it was a joining method of construction with little subduction, laser joining fully needs to stick the contact surface of a penetrable ingredient and an absorptivity ingredient, and it is necessary to weld it in this condition.
[0004]
Then, conventionally it is in the condition of having contacted the penetrable ingredient and the absorptivity ingredient, and the big force was applied to the contact surface from the outside, and the approach of raising the adhesion of the contact surface with this welding pressure is taken.
[0005]
[Problem(s) to be Solved by the Invention]
since the approach of securing the adhesion of the contact surface only with the pressure from the outside is taken in said conventional plastics joining approach -- an application-of-pressure means -- complexity -- while it enlarges and cost increases -- handling -- not easy -- moreover, **** -- even if it applies big external force, it does not restrict that the adhesion of the contact surface is always securable, but there is a problem that the stable joining reinforcement is not obtained in this case.
[0006]
This invention was not made in view of this present condition, and even if it is the case where the contact surface of both ingredients has not stuck, it aims at offering the plastics joining approach that the joining reinforcement which raised the degree of adhesion and was stabilized can be obtained.
[0007]
Other objects of this invention are to offer the plastics joining approach which can raise joining reinforcement substantially.
[0008]
Other objects of this invention shorten the time interval between preheating and laser joining, and are to offer the plastics joining approach which can raise the heating effectiveness by preheating.
[0009]
The object of further others of this invention heats only the contact surface for a short time, and is to offer the plastics joining approach that heat deformation of the whole ingredient accompanying preheating can be prevented.
[0010]
[Means for Solving the Problem]
This invention for attaining said object contacts the penetrable ingredient which has big laser beam

permeability, and the absorptivity ingredient which has small laser beam permeability, and irradiates semiconductor laser light into said penetrable ingredient in the contact surface with a through absorptivity ingredient. In the plastics joining approach which welds both ingredients, at least, preheating of one of the adhesion sides is carried out at the temperature more than the heat deflection temperature of an ingredient, and it is characterized by the thing of said penetrable ingredient or the absorptivity ingredients which both ingredients are subsequently contacted and was been made to perform laser joining. And since the contact surface of the ingredient which carried out preheating softens by said preheating, the degree of adhesion at the time of contacting the contact surface of both ingredients improves, and it becomes possible to obtain the joining reinforcement stabilized by this.

[0011]

After preheating, while this invention contacts both ingredients, it pressurizes and temporary welding of it is carried out again, and it is characterized by subsequently performing laser joining of both ingredients. And it becomes possible for the adhesion condition of the contact surface not to be spoiled by the application of pressure after preheating, and to raise joining reinforcement substantially by it, even if it is the case where a long time interval is between preheating and laser joining, since temporary joining of both the ingredients is carried out where the contact surface is stuck thoroughly.

[0012]

This invention is characterized by arranging a preheating means and making it evacuate a preheating means from between both ingredients after preheating among both ingredients again while it carries out opposite arrangement of a penetrable ingredient and the absorptivity ingredient. And thereby, only by moving both ingredients linearly, it becomes possible to contact the contact surface promptly after preheating, the time interval between preheating and laser joining is shortened, and it becomes possible to raise the heating effectiveness by preheating.

[0013]

It is characterized by this invention constituting further the hot plate allotted among both ingredients in a preheating means, and this hot plate from a source of heating heated by the electromagnetic-induction heating method. And thereby, only the contact surface is heated for a short time, and it becomes possible to prevent heat deformation of the whole ingredient accompanying preheating.

[0014]

[Embodiment of the Invention]

Hereafter, this invention is explained with reference to a drawing.

Drawing 1 thru/or drawing 5 are what shows the plastics joining approach concerning one gestalt of operation of this invention one by one according to work habits. A sign 1 among drawing To a soffit, for example, the 1st joining work piece and sign 3 which have the joining flange 2 which makes doughnut disc-like It is the 2nd joining work piece which has the joining flange 4 which makes doughnut disc-like in an upper bed. Both [these] the joining work pieces 1 and 3 Where the contact surfaces 2a and 4a of the joining flanges 2 and 4 are contacted mutually, joining is carried out by laser beam 5a from semiconductor laser 5 so that it may explain in full detail behind.

[0015]

The joining flange 2 of said 1st joining work piece 1 is formed with the penetrable ingredient which has big laser beam transmission, and, specifically, is formed with transparence or translucent plastics.

[0016]

Moreover, the joining flange 4 of said 2nd joining work piece 3 is formed with the absorptivity ingredient which has small laser beam permeability, and is formed with the plastics with which the opacifying pigment was specifically applied to opaque plastics or contact surface 4a by which toning was carried out to black etc. And as laser beam 5a from said semiconductor laser 5 is shown in drawing 4 , both the contact surfaces 2a and 4a irradiate through the joining flange 2 from the upper part of the joining flange 2, both the contact surfaces 2a and 4a fuse by this exposure, and joining of both the joining flanges 2 and 4 is carried out.

[0017]

As shown in drawing 1 , in advance of laser joining, preheating of the contact surfaces 2a and 4a of both [these] the joining flanges 2 and 4 is carried out using the preheating means 6 at the temperature more than the heat deflection temperature of both the joining work pieces 1 and 3, by this preheating, both the contact surfaces 2a and 4a can soften, and they can raise the degree of adhesion at the time of contacting both the contact surfaces 2a and 4a.

[0018]

The hot plate 7 doughnut disc-like for example, allotted between 1st joining WAHEKU 1 and the 2nd joining

work pieces 3 by which opposite arrangement was carried out up and down as said preheating means 6 is shown in drawing 1 , It consists of coils 8 for heating which are arranged at the periphery section of this hot plate 7, and heat a hot plate 7 by the electromagnetic-induction heating method, and at the temperature more than the heat deflection temperature of an ingredient, preheating of the contact surfaces 2a and 4a of both the joining flanges 2 and 4 is simultaneously carried out by said hot plate 7, and they are softened by it. And as said hot plate 7 is shown in drawing 2 , after preheating, it evacuates from between both the joining work pieces 1 and 3, and after evacuation of a hot plate 7, as shown in drawing 3 , where both the contact surfaces 2a and 4a are contacted, a pressure P is applied to both the joining work pieces 1 and 3, and temporary joining of both the joining flanges 2 and 4 is carried out to them.

[0019]

After temporary joining, as are shown in drawing 4 , and laser beam 5a is irradiated by both the contact surfaces 2a and 4a from the upper part of the joining flange 2, laser joining is performed and this shows drawing 5 , a product 10 completes both the joining work pieces 1 and 3.

[0020]

Next, an operation of the gestalt of this operation is explained.

While making the 1st joining work piece 1 and the 2nd joining work piece 3 counter at intervals of predetermined up and down on the occasion of joining as first shown in drawing 1 , the hot plate 7 of the preheating means 6 is arranged in the meantime. And it energizes in the coil 8 for heating, and a hot plate 7 is heated to the temperature more than the heat deflection temperature of both the joining work pieces 1 and 3. By this, preheating of the contact surfaces 2a and 4a of both the joining flanges 2 and 4 will be carried out simultaneously, and they will soften.

[0021]

By the way, the preheating means 6 has taken the approach of heating a hot plate 7 with an electromagnetic induction type. For this reason, since the configuration where the hot plate 7 was doubled with the configuration of the contact surfaces 2a and 4a can be processed, and only the contact surfaces 2a and 4a can be heated and a hot plate 7 is heated in an instant, only the front face of the contact surfaces 2a and 4a can be heated, and the joining flange 2 and the 4 whole can prevent carrying out heat deformation by preheating.

[0022]

Thus, while evacuating a hot plate 7 from between both the joining work pieces 1 and 3 as shown in drawing 2 if preheating is completed, both the joining work pieces 1 and 3 are made to approach, and the contact surfaces 2a and 4a of both the joining flanges 2 and 4 are contacted. And in this condition, as shown in drawing 3 , a pressure P is applied to both the joining work pieces 1 and 3, and temporary welding of both the joining flanges 2 and 4 is carried out.

[0023]

Under the present circumstances, since the contact surfaces 2a and 4a of both the joining flanges 2 and 4 are softened by preheating, where the whole surface of those contact surfaces 2a and 4a is stuck thoroughly, temporary joining of both the joining flanges 2 and 4 will be carried out. Moreover, since temporary joining of both the joining work pieces 1 and 3 is carried out, even if they are the cases where a long time interval is prepared between a temporary joining activity and the laser joining activity mentioned later, they do not have a possibility that the degree of adhesion of both the contact surfaces 2a and 4a may fall.

[0024]

Thus, if a temporary joining activity is completed, as shown in drawing 4 , laser beam 5a from [from the upper part of the joining flange 2] semiconductor laser 5 will be irradiated through the joining flange 2 in both the contact surfaces 2a and 4a. By this, both the contact surfaces 2a and 4a fuse, laser joining of both the joining flanges 2 and 4 is carried out, and the product 10 shown in drawing 5 is completed.

[0025]

Since a deer is carried out and it is made to carry out preheating of the contact surfaces 2a and 4a of both the joining flanges 2 and 4 before laser joining, even if it is the case that the degree of adhesion of both the contact surfaces 2a and 4a is bad, laser joining can be performed where both the contact surfaces 2a and 4a are stuck thoroughly. For this reason, the stable joining reinforcement can be obtained easily.

[0026]

In addition, in one gestalt of said operation, although the case where preheating of both contact surfaces 2a and 4a was carried out was explained, carrying out preheating of one of the contact surfaces 2a and 4a can also fully acquire expected effectiveness.

[0027]

Moreover, in one gestalt of said operation, although the case where preheating was carried out by the electromagnetic-induction heating method was explained, if the preheating of the contact surfaces 2a and 4a can be carried out, preheating can also be carried out by heating methods, such as a heater heating method, a hot blast heating method, an infrared lamp heating method, or a laser-heating method.
[0028]
Moreover, although temporary welding was once carried out and the case where laser welding was carried out was explained after preheating, it may be made to carry out laser welding in one gestalt of said operation promptly after preheating.
[0029]
[Example]
this invention person etc. conducted the experiment to which heat deflection temperature carries out laser welding of both the ingredients 20 and 30 using the penetrable ingredient (opalescence) 20 and the absorptivity ingredient (black) 30 made from PP which are 115 degrees C, as shown in drawing 6 . In addition, heights 30a was prepared in the front face of the absorptivity ingredient 30, and as shown in drawing 7 , when contacting both the ingredients 20 and 30, it was made only for heights 30a to contact.
[0030]
First, without carrying out preheating of both the ingredients 20 and 30, in the condition of having made it only contacting, this invention person irradiated semiconductor laser light from the upper part of the penetrable ingredient 20 in the contact surface of both the ingredients 20 and 30, and performed laser joining. Consequently, joining only of the part of heights 30a was carried out, but it was checked that joining of other parts is not carried out at all.
[0031]
Next, this invention person etc. performed laser joining by said same approach, after doing preheating of the contact surface of both the ingredients 20 and 30 at 100 degrees C of low temperature rather than the heat deflection temperature of both the ingredients 20 and 30. Consequently, it was checked that joining spots have produced heights 30a although joining also of the other part was carried out from the first.
[0032]
Further, this invention person etc. performed laser joining by said same approach, after doing preheating of the contact surface of both the ingredients 20 and 30 at hot 150 degrees C rather than the heat deflection temperature of both the ingredients 20 and 30. Consequently, as for heights 30a, it was checked from the first that joining also of the other part is carried out and joining is moreover thoroughly carried out for all fields.
[0033]
Even if it was the case that the degree of adhesion of the contact surface was bad, when carrying out preheating in advance of laser joining from the above thing, it could weld also in the part which has not been stuck and preheating was understood that it is required to carry out at the temperature more than the heat deflection temperature of ingredients 20 and 30.
[0034]
[Effect of the Invention]
As explained above, this invention contacts the penetrable ingredient which has big laser beam permeability, and the absorptivity ingredient which has small laser beam permeability, and irradiates semiconductor laser light into said penetrable ingredient in the contact surface with a through absorptivity ingredient. In the plastics joining approach which welds both ingredients at least of said penetrable ingredient or the absorptivity ingredients one of adhesion sides Since preheating is carried out at the temperature more than the heat deflection temperature of an ingredient, both ingredients are subsequently contacted and it is made to perform laser joining, the contact surface of the ingredient which carried out preheating can soften by said preheating, and the degree of adhesion at the time of contacting the contact surface of both ingredients can be raised. And thereby, the stable joining reinforcement can be obtained.
[0035]
Since it pressurizes and temporary welding of it is carried out after preheating again, while this invention contacts both ingredients, and it is subsequently made to perform laser joining of both ingredients Where the contact surface is stuck thoroughly, temporary joining of both the ingredients is carried out, even if it is the case where a long time interval is between preheating and laser joining, the adhesion condition of the contact surface is not spoiled by the application of pressure after preheating, and joining reinforcement can be substantially raised by it.
[0036]
While this invention carries out opposite arrangement of a penetrable ingredient and the absorptivity

ingredient, again Since a preheating means is arranged and he is trying to evacuate a preheating means from between both ingredients after preheating among both ingredients Only by moving both ingredients linearly, the contact surface can be promptly contacted after preheating, the time interval between preheating and laser joining can be shortened, and the heating effectiveness by preheating can be raised.

[0037]

Since he is trying for this invention to constitute further the hot plate allotted among both ingredients in a preheating means, and this hot plate from a source of heating heated by the electromagnetic-induction heating method, only the contact surface can be heated in a short time, and heat deformation of the whole ingredient accompanying preheating can be prevented.

[Brief Description of the Drawings]

[Drawing 1] It is the explanatory view showing the plastics joining approach concerning one gestalt of operation of this invention.

[Drawing 2] It is the explanatory view showing the condition of having evacuated the hot plate for preheating, from the condition of drawing 1 .

[Drawing 3] It is the explanatory view showing the condition of pressurizing and carrying out temporary welding of both the joining work piece.

[Drawing 4] It is the explanatory view showing the condition of performing laser joining after temporary joining.

[Drawing 5] It is the explanatory view showing the product completed by laser joining.

[Drawing 6] It is the explanatory view showing the penetrable ingredient and absorptivity ingredient which were used in the experiment which this invention person conducted.

[Drawing 7] It is the explanatory view showing the condition of performing laser joining using both the ingredients of drawing 6 .

[Description of Notations]

1 1st Joining Work Piece
2 Four Joining flange
2a and 4a Contact surface
3 2nd Joining Work Piece
5 Semiconductor Laser
5a Laser beam
6 Preheating Means
7 Hot Plate
8 Coil for Heating
10 Product
P Pressure

[Translation done.]

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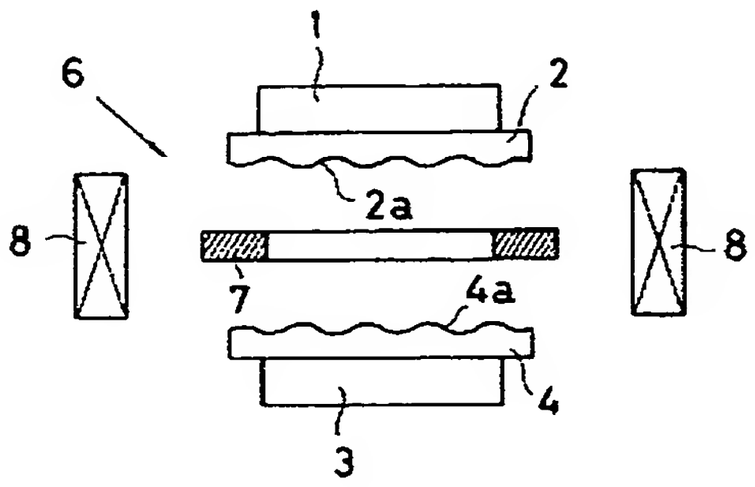
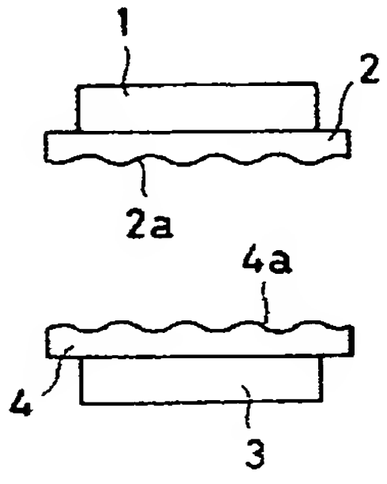
DRAWINGS

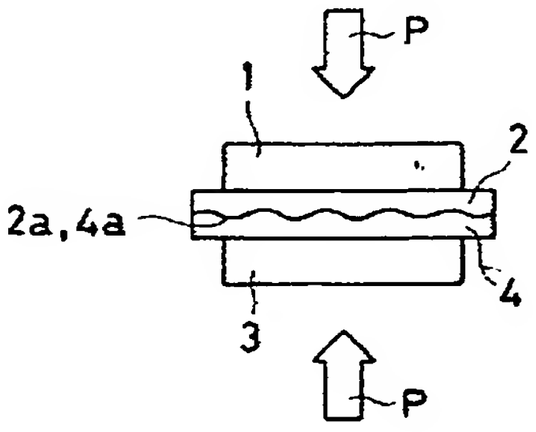
[Drawing 1]



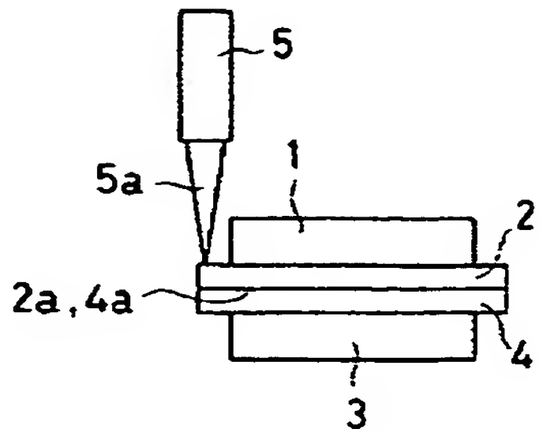
[Drawing 2]



[Drawing 3]



[Drawing 4]



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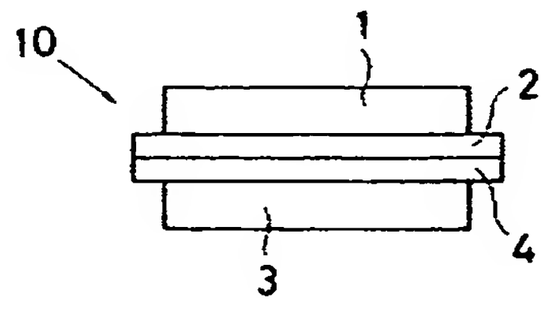
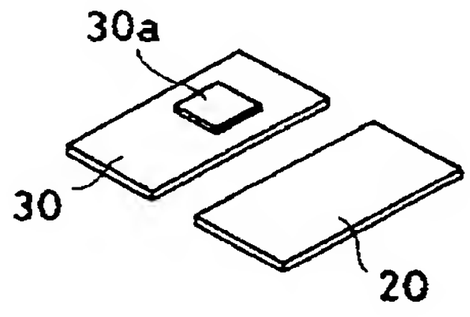
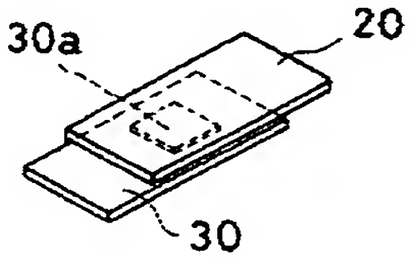


[Drawing 6]



[Drawing 7]



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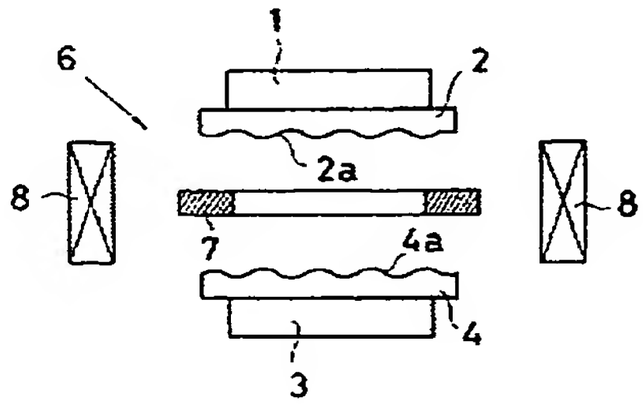
最終頁に続く

(54)【発明の名称】プラスチック溶着方法

(57)【要約】
【課題】半導体レーザを用いてレーザ溶着を行なう際に、溶着ワークの接触面の密着性が悪い場合であっても、安定した溶着強度が得られるようにする。
【解決手段】第１溶着ワーク１の溶着フランジ２と、第２溶着ワーク３の溶着フランジ４とを接触させてレーザ溶着を行なう場合、レーザ溶着に先立って、両接触面２ａ，４ａを、両溶着ワーク１，３の熱変形温度以上の温度で予備加熱する。予備加熱は、加熱板７と加熱用コイル８とを用い、電磁誘導加熱方式で行なう。この予備加熱により、両接触面２ａ，４ａが軟化し、両接触面２ａ，４ａを接触させてレーザ溶着する際に、その密着度を向上させることができる。
【選択図】 図１



【特許請求の範囲】
【請求項１】
大きなレーザ光透過率を有する透過性材料と小さなレーザ光透過率を有する吸収性材料とを接触させ、前記透過性材料を通し吸収性材料との接触面に半導体レーザ光を照射して、両材料を溶着するプラスチック溶着方法において、前記透過性材料または吸収性材料のうちの少なくともいずれか一方の接着面を、材料の熱変形温度以上の温度で予備加熱し、次いで両材料を接触させてレーザ溶着を行なうことを特徴とするプラスチック溶着方法。
【請求項２】
予備加熱後、両材料を接触させるとともに加圧して仮溶着し、次いで両材料のレーザ溶着を行なうことを特徴とする請求項１記載のプラスチック溶着方法。
【請求項３】
透過性材料と吸収性材料とを対向配置するとともに、両材料の間に予備加熱手段を配置し、予備加熱後、予備加熱手段を両材料の間から退避させることを特徴とする請求項１または２記載のプラスチック溶着方法。
【請求項４】
予備加熱手段は、両材料の間に配される加熱板と、この加熱板を電磁誘導加熱方式で加熱する加熱源とを備えていることを特徴とする請求項３記載のプラスチック溶着方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、半導体レーザを用いてプラスチック材を溶着するプラスチック溶着方法に係り、特に接触面の密着性が悪い場合であっても、安定した溶着強度を得ることができるプラスチック溶着方法に関する。
【０００２】
【従来の技術】
従来から、大きなレーザ透過率を有する透過性材料と小さなレーザ光透過率を有する吸収性材料とを重ね合わせ、透過性材料の外側から両材料の接触面に半導体レーザ光を照射して、両材料を溶着するプラスチック溶着方法は一般に知られている。
【０００３】
ところで、レーザ溶着は沈み込みの少ない溶着工法であるため、安定した溶着状態を得るためには、透過性材料と吸収性材料との接触面を充分に密着させ、この状態で溶着する必要がある。
【０００４】
そこで従来は、透過性材料と吸収性材料とを接触させた状態で、接触面に外部から大きな力を加え、この加圧力で接触面の密着性を向上させる方法を採っている。
【０００５】
【発明が解決しようとする課題】
前記従来のプラスチック溶着方法においては、外部からの圧力のみにより接触面の密着性を確保する方法を採っているため、加圧手段が複雑，大型化してコストが嵩むとともに、取扱いも容易でなく、また仮令大きな外力を加えても、接触面の密着性を常に確保できるとは限らず、この場合には、安定した溶着強度が得られないという問題がある。
【０００６】
本発明は、かかる現況に鑑みなされたもので、両材料の接触面が密着していない場合であっても、密着度を向上させて安定した溶着強度を得ることができるプラスチック溶着方法を提供することを目的とする。
【０００７】
本発明の他の目的は、溶着強度を大幅に向上させることができるプラスチック溶着方法を提供するにある。
【０００８】
本発明の他の目的は、予備加熱とレーザ溶着との間の時間間隔を短くして、予備加熱によ

る加熱効果を向上させることができるプラスチック溶着方法を提供するにある。
【０００９】
本発明のさらに他の目的は、接触面のみを短時間で加熱し、予備加熱に伴なう材料全体の熱変形を防止することができるプラスチック溶着方法を提供するにある。
【００１０】
【課題を解決するための手段】
前記目的を達成するための本発明は、大きなレーザ光透過率を有する透過性材料と小さなレーザ光透過率を有する吸収性材料とを接触させ、前記透過性材料を通し吸収性材料との接触面に半導体レーザ光を照射して、両材料を溶着するプラスチック溶着方法において、前記透過性材料または吸収性材料のうちの少なくともいずれか一方の接着面を、材料の熱変形温度以上の温度で予備加熱し、次いで両材料を接触させてレーザ溶着を行なうようにしたことを特徴とする。そして、前記予備加熱により、予備加熱した材料の接触面が軟化するので、両材料の接触面を接触させた際の密着度が向上し、これにより安定した溶着強度を得ることが可能となる。
【００１１】
本発明はまた、予備加熱後、両材料を接触させるとともに加圧して仮溶着し、次いで両材料のレーザ溶着を行なうようにしたことを特徴とする。そして、予備加熱後の加圧により、両材料が接触面を完全に密着させた状態で仮溶着されるので、予備加熱とレーザ溶着との間に長い時間間隔がある場合であっても、接触面の密着状態が損なわれることがなく、溶着強度を大幅に向上させることが可能となる。
【００１２】
本発明はまた、透過性材料と吸収性材料とを対向配置するとともに、両材料の間に予備加熱手段を配置し、予備加熱後、予備加熱手段を両材料の間から退避させるようにしたことを特徴とする。そしてこれにより、両材料を直線的に移動させるだけで、予備加熱後直ちに接触面を接触させることが可能となり、予備加熱とレーザ溶着との間の時間間隔を短くして、予備加熱による加熱効果を向上させることが可能となる。
【００１３】
本発明はさらに、予備加熱手段を、両材料の間に配される加熱板と、この加熱板を電磁誘導加熱方式で加熱する加熱源とで構成するようにしたことを特徴とする。そしてこれにより、接触面のみを短時間で加熱し、予備加熱に伴なう材料全体の熱変形を防止することが可能となる。
【００１４】
【発明の実施の形態】
以下、本発明を図面を参照して説明する。
図１ないし図５は、本発明の実施の一形態に係るプラスチック溶着方法を、作業手順に従って順次示すもので、図中、符号１は、下端に例えばドーナツ円板状をなす溶着フランジ２を有する第１溶着ワーク、符号３は、上端に例えばドーナツ円板状をなす溶着フランジ４を有する第２溶着ワークであり、これら両溶着ワーク１，３は、後に詳述するように、その溶着フランジ２，４の接触面２ａ，４ａを相互に接触させた状態で、半導体レーザ５からのレーザ光５ａにより溶着されるようになっている。
【００１５】
前記第１溶着ワーク１の溶着フランジ２は、大きなレーザ光透過率を有する透過性材料で形成されており、具体的には、透明または半透明のプラスチック等で形成されている。
【００１６】
また、前記第２溶着ワーク３の溶着フランジ４は、小さなレーザ光透過率を有する吸収性材料で形成されており、具体的には、黒色等に調色された不透明プラスチックあるいは接触面４ａに不透明顔料が塗布されたプラスチック等で形成されている。そして、前記半導体レーザ５からのレーザ光５ａは、図４に示すように、溶着フランジ２の上方から溶着フランジ２を通って両接触面２ａ，４ａに照射されるようになっており、この照射により両接触面２ａ，４ａが溶融して、両溶着フランジ２，４が溶着されるようになっている。

【００１７】
これら両溶着フランジ２，４の接触面２ａ，４ａは、図１に示すように、レーザ溶着に先立ち、予備加熱手段６を用い両溶着ワーク１，３の熱変形温度以上の温度で予備加熱されるようになっており、この予備加熱により、両接触面２ａ，４ａが軟化して、両接触面２ａ，４ａを接触させた際の密着度を向上させることができるようになっている。
【００１８】
前記予備加熱手段６は、図１に示すように、上下に対向配置された第１溶着ワヘーク１と第２溶着ワーク３との間に配される例えばドーナツ円板状の加熱板７と、この加熱板７の外周部に配置され加熱板７を電磁誘導加熱方式で加熱する加熱用コイル８とで構成されており、両溶着フランジ２，４の接触面２ａ，４ａは、前記加熱板７により、材料の熱変形温度以上の温度で同時に予備加熱されて軟化するようになっている。そして前記加熱板７は、図２に示すように、予備加熱後、両溶着ワーク１，３の間から退避するようになっており、加熱板７の退避後、両溶着ワーク１，３には、図３に示すように、両接触面２ａ，４ａを接触させた状態で圧力Ｐが加えられ、両溶着フランジ２，４が仮溶着されるようになっている。
【００１９】
仮溶着後、両溶着ワーク１，３は、図４に示すように、両接触面２ａ，４ａに、溶着フランジ２の上方からレーザ光５ａが照射され、レーザ溶着が行なわれるようになっており、これにより、図５に示すように、製品１０が完成するようになっている。
【００２０】
次に、本実施の形態の作用について説明する。
溶着に際しては、まず図１に示すように、第１溶着ワーク１と第２溶着ワーク３とを、上下に所定間隔で対向させるとともに、その間に予備加熱手段６の加熱板７を配置する。そして、加熱用コイル８に通電して、加熱板７を両溶着ワーク１，３の熱変形温度以上の温度まで加熱する。これにより、両溶着フランジ２，４の接触面２ａ，４ａが、同時に予備加熱されて軟化することになる。
【００２１】
ところで、予備加熱手段６は、電磁誘導方式で加熱板７を加熱する方法を採っている。このため、加熱板７を接触面２ａ，４ａの形状に合わせた形状に加工して、接触面２ａ，４ａのみを加熱することができ、また加熱板７は、瞬時に加熱されるので、接触面２ａ，４ａの表面のみを加熱して、溶着フランジ２，４全体が、予備加熱によって熱変形するのを防止することができる。
【００２２】
このようにして、予備加熱が終了したならば、図２に示すように、加熱板７を両溶着ワーク１，３の間から退避させるとともに、両溶着ワーク１，３を接近させて、両溶着フランジ２，４の接触面２ａ，４ａを接触させる。そしてこの状態で、図３に示すように、両溶着ワーク１，３に圧力Ｐを加えて、両溶着フランジ２，４を仮溶着する。
【００２３】
この際、両溶着フランジ２，４の接触面２ａ，４ａは、予備加熱により軟化しているので、両溶着フランジ２，４は、その接触面２ａ，４ａの全面を完全に密着させた状態で仮溶着されることになる。また、両溶着ワーク１，３は、仮溶着されているので、仮溶着作業と後述するレーザ溶着作業との間に長い時間間隔を設けた場合であっても、両接触面２ａ，４ａの密着度が低下するおそれが全くない。
【００２４】
このようにして仮溶着作業が終了したならば、図４に示すように、溶着フランジ２の上方から、半導体レーザ５からのレーザ光５ａを、溶着フランジ２を通して両接触面２ａ，４ａに照射する。これにより、両接触面２ａ，４ａが溶融して両溶着フランジ２，４がレーザ溶着され、図５に示す製品１０が完成する。
【００２５】
しかして、レーザ溶着の前に、両溶着フランジ２，４の接触面２ａ，４ａを予備加熱する

ようにしているので、両接触面２ａ，４ａの密着度が悪い場合であっても、両接触面２ａ，４ａを完全に密着させた状態でレーザ溶着を行なうことができる。このため、安定した溶着強度を容易に得ることができる。

【００２６】

なお、前記実施の一形態においては、両方の接触面２ａ，４ａを予備加熱する場合について説明したが、いずれか一方の接触面２ａ，４ａを予備加熱するだけでも、所期の効果は充分に得ることができる。

【００２７】

また、前記実施の一形態においては、電磁誘導加熱方式で予備加熱する場合について説明したが、接触面２ａ，４ａを予備加熱できるのであれば、ヒータ加熱方式，熱風加熱方式，赤外線ランプ加熱方式あるいはレーザ加熱方式等の加熱方式で予備加熱することもできる。

【００２８】

また、前記実施の一形態においては、予備加熱の後、一旦仮溶着してレーザ溶着する場合について説明したが、予備加熱後、直ちにレーザ溶着するようにしてもよい。

【００２９】

【実施例】

本発明者等は、図６に示すように、熱変形温度が１１５℃のＰＰ製の透過性材料（乳白色）２０と吸収性材料（黒色）３０とを用い、両材料２０，３０をレーザ溶着する実験を行なった。なお、吸収性材料３０の表面には凸部３０ａを設け、図７に示すように、両材料２０，３０を接触させた際には、凸部３０ａのみが接触するようにした。

【００３０】

本発明者はまず、両材料２０，３０を予備加熱せずに、単に接触させた状態で、半導体レーザ光を透過性材料２０の上方から両材料２０，３０の接触面に照射して、レーザ溶着を行なった。その結果、凸部３０ａの部分しか溶着されず、他の部分は全く溶着されないことが確認された。

【００３１】

本発明者等は次に、両材料２０，３０の接触面を、両材料２０，３０の熱変形温度よりも低温の１００℃で予備加熱した後、前記同様の方法でレーザ溶着を行なった。その結果、凸部３０ａはもとより、それ以外の部分も溶着されたが、溶着斑が生じていることが確認された。

【００３２】

本発明者等はさらに、両材料２０，３０の接触面を、両材料２０，３０の熱変形温度よりも高温の１５０℃で予備加熱した後、前記同様の方法でレーザ溶着を行なった。その結果、凸部３０ａはもとより、それ以外の部分も溶着され、しかもすべての領域が完全に溶着されていることが確認された。

【００３３】

以上のことから、接触面の密着度が悪い場合であっても、レーザ溶着に先立って予備加熱すれば、密着していない部分でも溶着することができ、また予備加熱は、材料２０，３０の熱変形温度以上の温度で行なうことが必要であることが判った。

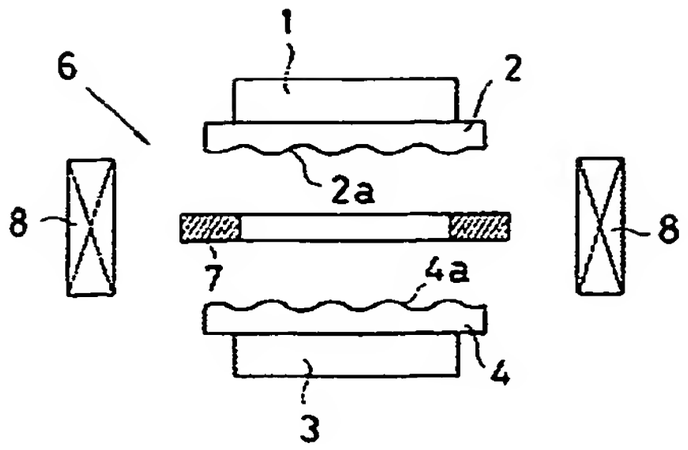
【００３４】

【発明の効果】

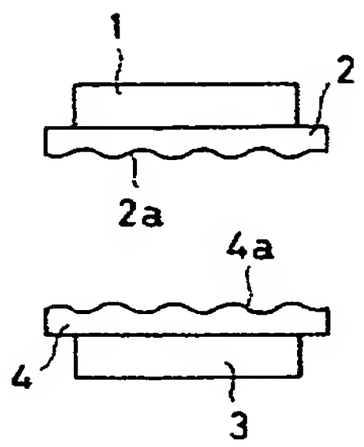
以上説明したように本発明は、大きなレーザ光透過率を有する透過性材料と小さなレーザ光透過率を有する吸収性材料とを接触させ、前記透過性材料を通し吸収性材料との接触面に半導体レーザ光を照射して、両材料を溶着するプラスチック溶着方法において、前記透過性材料または吸収性材料のうちの少なくともいずれか一方の接着面を、材料の熱変形温度以上の温度で予備加熱し、次いで両材料を接触させてレーザ溶着を行なうようにしているので、前記予備加熱により、予備加熱した材料の接触面が軟化し、両材料の接触面を接触させた際の密着度を向上させることができる。そして、これにより、安定した溶着強度を得ることができる。

【００３５】
本発明はまた、予備加熱後、両材料を接触させるとともに加圧して仮溶着し、次いで両材料のレーザ溶着を行なうようにしているので、予備加熱後の加圧により、両材料が接触面を完全に密着させた状態で仮溶着され、予備加熱とレーザ溶着との間に長い時間間隔がある場合であっても、接触面の密着状態が損なわれることがなく、溶着強度を大幅に向上させることができる。
【００３６】
本発明はまた、透過性材料と吸収性材料とを対向配置するとともに、両材料の間に予備加熱手段を配置し、予備加熱後、予備加熱手段を両材料の間から退避させるようにしているので、両材料を直線的に移動させるだけで、予備加熱後直ちに接触面を接触させることができ、予備加熱とレーザ溶着との間の時間間隔を短くして、予備加熱による加熱効果を向上させることができる。
【００３７】
本発明はさらに、予備加熱手段を、両材料の間に配される加熱板と、この加熱板を電磁誘導加熱方式で加熱する加熱源とで構成するようにしているので、接触面のみを短時間で加熱し、予備加熱に伴なう材料全体の熱変形を防止することができる。
【図面の簡単な説明】
【図１】本発明の実施の一形態に係るプラスチック溶着方法を示す説明図である。
【図２】図１の状態から、予備加熱用の加熱板を退避させた状態を示す説明図である。
【図３】両溶着ワークを加圧して仮溶着している状態を示す説明図である。
【図４】仮溶着後、レーザ溶着を行なっている状態を示す説明図である。
【図５】レーザ溶着により完成した製品を示す説明図である。
【図６】本発明者が行なった実験で用いられた透過性材料および吸収性材料を示す説明図である。
【図７】図６の両材料を用いてレーザ溶着を行なっている状態を示す説明図である。
【符号の説明】
１　第１溶着ワーク
２，４　溶着フランジ
２ａ，４ａ　接触面
３　第２溶着ワーク
５　半導体レーザ
５ａ　レーザ光
６　予備加熱手段
７　加熱板
８　加熱用コイル
１０　製品
Ｐ　圧力

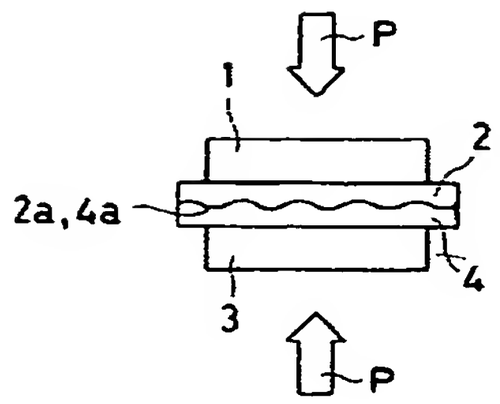
【図１】



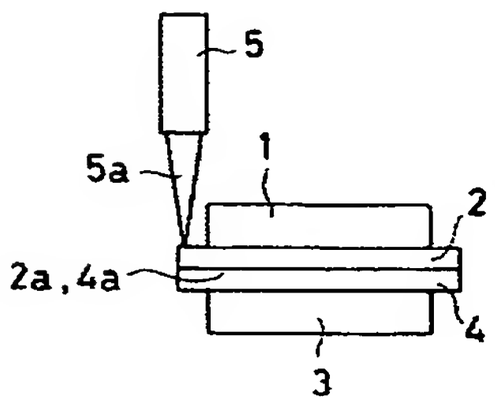
【図２】



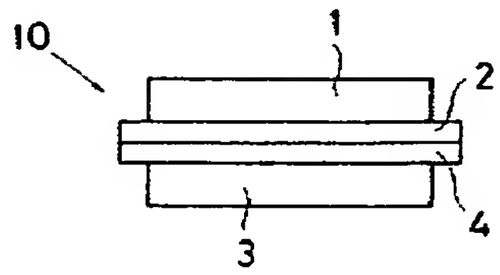
【図３】



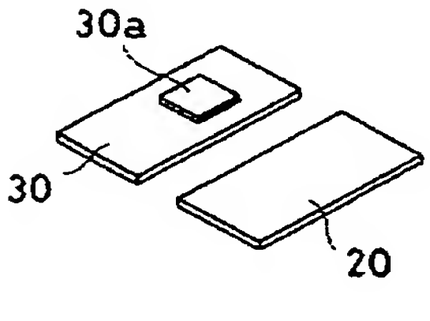
【図４】



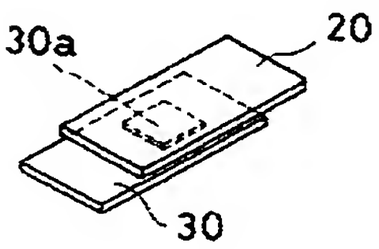
【図５】



【図６】



【図７】



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